Volume : II Effective Date :
Chapter : 3 Revision Date : 05/15/2002
Section : 1 Subject : **GUARD RAIL**
Directive : 3

1. **PURPOSE**: The purpose of this directive is to establish a policy for implementation of Guard Rail Standard Plans GR-200, GR-201, and GR-202 on existing highways and bridges. This directive also establishes exceptions which may be taken when conditions do not allow application of the most desirable practice.

2. **SCOPE**: This directive affects guard railing on existing highways and structures. All requirements and exceptions set herein are exclusively for placement of guard rails on existing roads and bridges and are not intended to modify the contents of the Guard Rail Standard Plans.

3. **POLICY**: It will be the policy of the Department of Transportation and Development to apply the same Guard Rail Standard Plans to both new and existing highways and structures. Because the application of these Standards to existing conditions is often impractical, guidelines and exceptions set herein will aid the designers to arrive at the most effective solution to their problems.

   Any deviation from these guidelines and exceptions will require a design exception from the Office of the Chief Engineer.

   The Guidelines and Exceptions are as follows:

   A. When roadway and right-of-way conditions permit, guard rails shall be designed with the maximum allowable flare rate, in accordance with Standard Plan GR-200. All new guard rails installed on existing Interstate highways shall meet the requirements of the Standard Plan GR-200. Exceptions for length of need for guard rail set here in will not be allowed on interstate highways.

   B. When roadway and right-of-way restrictions do not allow installation of guard rail as described above, the following equation shall determine the guard rail length in lieu of the equation given on Standard Plan GR-200.

$$x = \frac{Lh + b/a(L1) - L2}{b/a + 0.1763}$$

x	=	Length of need
Lh	=	Lateral extent of hazard. When designing guard rail for bridge ends, use Lc. Lc is the clear zone distance as shown on Standard Plan GR-200.
b/a	=	Flare rate of guard rail
L1	=	Tangent section of guard rail in advance of hazard (usually 31.25 ft.)
L2	=	Distance from edge of pavement to tangent section of guard rail.

   0.1763 = Tangent of departure angle, the departure angle is 10 degrees.

Total offset "Y" from the edge of pavement shall be computed from the following equation:

$Y = Lh - x(0.1763)$

When computing "X", the maximum allowable flare rate in accordance with Standard Plan GR-200 shall be incorporated in the computation. When the field conditions do not allow the use of maximum flare rate, a reduction in the flare rate is allowed; however, the guard rail length shall be recomputed, based on the reduced flare rate.

C. When guard rails are designed with a flare rate of zero, the preceding equation for computation of **"x"** can be simplified to:

$$x = \frac{Lh - L2}{0.1763}$$

D. When off-set "Y" has to be set due to insufficient right-of-way, use the following equation to find the required length of need "X":

$$x = \frac{Lh - Y}{0.1763}$$

E. Under no circumstances shall the required off-set for the flared guard rail end treatment be reduced, or modified in any form. In situations where the guard rail must be placed with no flare in its entire length, other approved crash worthy tangent end treatments may be considered for use.

F. The minimum guard rail length shall be no shorter than 75 ft. (length of need, x = 62'- 6"). This requirement will apply, even if the equation yields a smaller value. In cases where the bridge railing is flexible, the transition section may be eliminated if necessary. This will result in connecting an approved guard rail end treatment section to the flexible bridge railing.

G. When intersections near bridge ends prohibit installation of typical guard rail length in accordance with preceding instructions, the T- intersection details shown on Standard Plan GR-200 may be used.

H. When placing guard rail at the ends of bridge rail, a thrie-beam transition shall be used. In all cases where the bridge rail is considered rigid, such as all concrete rails, the double thrie-beam transition must be chosen, and shall be connected to the bridge railing in accordance with the Standard Plan GR-200. On existing bridges it may be necessary to construct an end block at the end of the bridge rail to properly connect the transition section to the bridge. Refer to the Bridge Design Section guard rail special details for further information.

However, in the majority of cases end blocks can be avoided if connections are strategically accomplished. For examples on safety shape concrete barriers a crash tested detail is provided which accommodates the guard rail to barrier connection without the use of an end block. Refer to the Bridge Design Section guard rail special details for further information.

In many cases where bridge railing is comprised of some type of curbed parapet, a transition connection can be accomplished by proper blocking of the guard rail. Refer to the Bridge Design Section guard rail special details for further information.

When the bridge rail is flexible, such as a guard rail connected to steel or wood posts, the thrie-beam transition may be used. For details refer to Standard Plan GR-200. A guard rail transition section in advance of a flexible bridge railing may be eliminated if full length guard rail is not practical.

I. Bridge rails with curbed sidewalks need not be protected with guard rail, when they are located in urban sections or have a design speed of 45 mph or lower. See EDSM II.3.1.4 for further information.

For design speeds of more than 45 mph, when sidewalks are involved, guard rails shall be designed on a case by case basis. Under such conditions, prime consideration shall be given to separating pedestrians from vehicular traffic, via an approved traffic barrier. Such traffic barriers shall have a crash worthy end treatment.

J. If in some cases, standard details that are available herein do not align with a certain type of bridge railing on a structure, a detail of that type of railing and the transition connection may be requested from the DOTD Bridge Design Section.

K. When placing guard rail at the end of a flexible bridge rail, the bridge rail shall be inspected, to insure its structural integrity. If the bridge rail proves to be deteriorated, it shall be removed and replaced under an appropriate pay item. If a W-Beam rail element is present on the bridge, it shall be removed and replaced with blocked out thrie beam rail.
Refer to the Bridge Design Section guard rail special details for further information.

L. When bridges are relatively short or where there is little space between them, it is preferred practice to carry the guard rail beam element along the length of the bridge rail, and between the bridges, rather than terminating it near the end of the bridge, or between the bridges.

M. Occasionally, bridge surfaces are overlaid with a wearing coarse. This will often reduce the effective height of the bridge rail and can become critical in the containment of an errant vehicle, particularly when the bridge rail is located a short distance behind the curb. The reduced curb height increases the potential for an errant vehicle to climb over the curb and become airborne over the bridge railing. To remedy such conditions it is necessary that the thrie-beam rail element be carried along the bridge rail and be blocked out in such a manner that the face of the rail element is flush with the bridge curb line.

In general, when curbs are in front of bridge railings, continuation of the guard rail beam element along the bridge length at the face of the curb is strongly recommended. Instead of using a terminal connector, the guard rail may be lapped at the bridge end and continued along the bridge railing. This practice will eliminate curb vaulting along the bridge length and will improve safety**.** Refer to the Bridge Design Section guard rail special details for further information.

In the urban sections, a precast concrete barrier panel system should be considered (due to traffic, durability and aesthetics) to retrofit existing urban bridge barrier parapet/brush curbs instead of using the alternate blocked out thrie-beam rail retrofit detail. The Bridge Design Section will provide typical barrier panel details when requested.

N. For protecting roadside hazards such as bridge columns, overhead sign posts, etc. refer to Standard Plan GR-201.

O. For guard rails on culverts, refer to the Standard Plan GR-202.

P. A minimum of 2 ft. clearance is required from the back of the guard rail post to the break point of the ground slope behind the post. If the post needs to be placed closer to or at the break point, the guard rail post shall be lengthened by 1 ft. The 1 ft. addition to the post shall be placed in the ground.

Q. The guard rail design shall be based on the design speed set for the particular highway in consideration. However, if the operating speed proves to be well above the design speed, it is recommended that guard rail design based on operating speed be given serious consideration.

R. All detour bridges shall be protected with at least the minimum guard rail length.

S. When roadways are overlaid with asphalt or other bituminous material, the height of the existing guard rail will be reduced. If the overall height of the guard rail is reduced to less than 2 ft., it shall be removed and replaced with new guard rail. (The overall guard rail height shall be measured from the top of the ground to the top of the rail.)

   At the discretion of the project engineer, the old guard rail may be salvaged by the contractor and stored at a DOTD storage yard for future use. Guard rail removal shall be paid for under an appropriate item.

T. The Bridge Design Section maintains guard rail special details for use on existing bridges and highways. The details include retrofit for flexible rail for bridges and box culverts, retrofit for bridge barrier rail, bridge anchor block retrofit and bridge brush curb retrofit. The details are used in conjunction with Standard Plan GR-200. Copies of these special details may be obtained from the Bridge Design Section for use on Department projects.

4. **OTHER ISSUANCES AFFECTED**: All directives, memoranda, or instructions issued in conflict with this directive are hereby rescinded.

5. **EFFECTIVE DATE**: This directive will be effective immediately upon receipt.

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